COMPARATIVE STIFFNESS ANALYSIS BETWEEN CONVENTIONAL AND IBS CONSTRUCTION METHOD

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Dedication

For My beloved Wife, Sons, Daughters, Mum, Brothers, Sister, friends and also my staffs
May God Bless U All` ~ Nsr

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ABSTRACT

Industrialised Building System (IBS) is a system where the components such as beam, columns and floors are produced in the factory with standard sizes and length. These components are then transported to the construction site for assembly to form buildings.

The analysis and design of the IBS structures, like any other building analysis is dependent on the loads, sizes of properties structures (columns, beam and floors) and joints restraints.

In this study, the continuous steel bars in the conventional construction method is replaced by rectangular hollow sections for the column to column connections and two steel plates for the beam to column connection. The stiffness restraints this type IBS is found to be nearer to conventional reinforced concrete constructions.

It also means that during constructions the joint can be left as it is or grouted with the same concrete strength to the columns and beam. The analysis is carried out using Multiframe 4D software.

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CHAPTER 1

INTRODUCTION

1.1 Prefabricated buildings

The precast industry is still laboring under the misconceptions of modular precast concrete buildings. . This is not surprising because engineers designs the industrialized building systems on the modular grid. Actually there is a clear distinction between “modular coordination” and standardization”. The precast industry deplores the former and encourages the latter.

Modularization offers zero flexibility of the modular grid. Interior architectural freedom is possible only in the adoption of module quantities and configuration, and one cannot escape the geometrical dominance and lack of individuality of these buildings.

As far as skeletal frames are concerned, one need go no further than the standardization of families of precast concrete components to obtain the optimum solution for any building.

Standardization is different from modulation. It refers to the manner in which a set of predetermined components are used and connected. Most of the buildings were constructed using the same family of standardized components.

By adjusting beam depths, column lengths, wall positions etc. the same components in any these buildings could have been used to make a completely different structure. This is not possible with modular systems.

There are three basic types of precast structures namely:-

i) the **wall** frame, Figure 1.1, consisting of vertical wall and horizontal slab units only, and used extensively for multi-storey hotels, retail units, hospitals, and offices. The structural walls serve also as partitioning;

ii) the **portal** frame, Figure 1.2 consisting of columns and roof rafters, and used for single storey retail warehousing and industrial manufacturing facilities;

iii) the **skeletal** structure, Figure 1.3 consisting of columns, beams and slabs for low rise buildings, with a small number of walls for high rise. Skeletal frames used chiefly for schools, commercial offices and car parks.

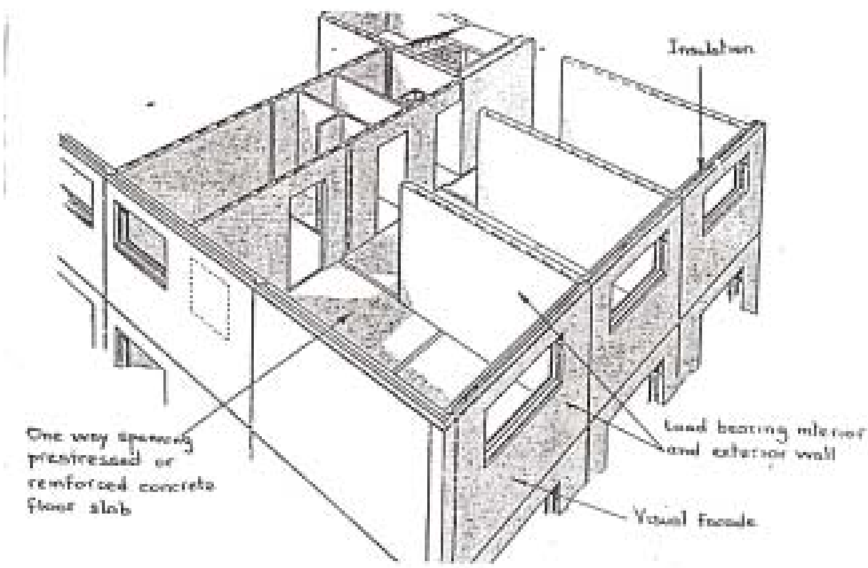

Figure 1.1: Wall frames

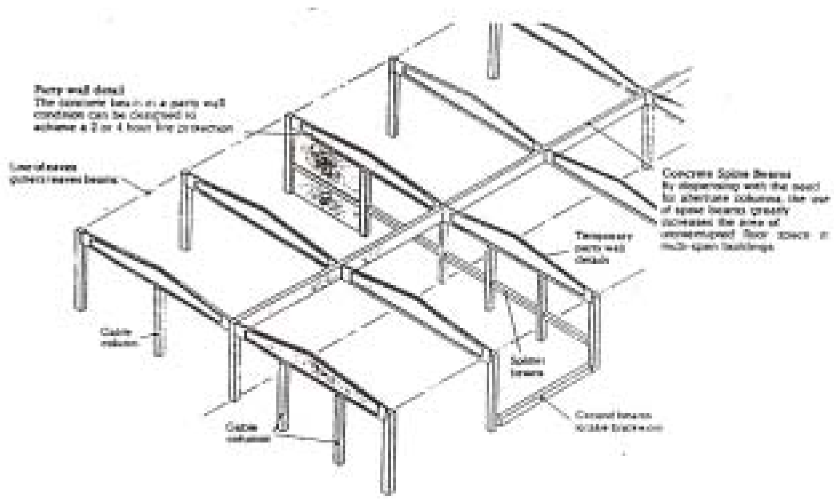

Figure 1.2 : Portal Frames

Figure 1.3 :Skeletal Structures

1.2 Problem Statement

In Malaysia, the industrialised building system had started fourty years ago but until today it is still experimenting with various prebfabricated method.

Recently, The Government of Malaysia encourages the use of IBS especially in new government office building projects. For the start , the government insist that the office building shall have at least 50% IBS components.

To make the IBS industry materialise, research has to be carried out to standardise the IBS components especially the beams and column. This will make IBS more marketable.

In this study, we are trying to find the solution for the frame structures whereby the components are standardise according to the normal market use. Analysis has to be carried out to determine the strength and stiffness of the components and its connections.

The following steps are suggested ‘

1. Standardise the beams and columns sizes and length.
2. Analyse the stiffness of the beam-to-column and column-to-column stiffness.

1.3 Objective

The objectives of this study are:

1. To model the frame for first degree of analysis using MULTIFRAME 4D SOFTWARE.

2. To analyse the frame structure model to determine the critical behaviour upon the loading applied.

3. To obtain the maximum stresses due to displacement and rotation to recognize the failure of the frame structure.

1.4 Scope of study

This research is focused on the behavior of the connection of the frame structure which consists of displacement, rotation, and deflection failure. MULTIFRAME 4D is used to model the frame structure. The first degree element analysis is carried out without comparing with the laboratory test. The frame model in this analysis is a 6-storeys IBS structure to determine its connections stiffness suitability in comparision with the conventional structures of the same structure, loadings, and joint rigidity.

1.5 Research Methodology

The research methodology include;

a) Information gathering

The actual building plan is obtained from the architect. The plan is meant for the Johor State New Administrative Centre in Bandar Nusajaya, Johor Bahru, Johor.

b) First Degree Element Analysis Software

MULTIFRAME 4D is used to model the structure. In modelling the structure it shall include the section properties, loadings, and joints restraints.

c) Modelling

Geometry modelling is based on engineering drawing. The structure is directly modelled using MULTIFRAME 4D software. The loadings and restraints are determined here. The section properties are modelled in the multiframe section maker software and exported to the MULTIFRAME 4D in the section library.

d) Analysis of IBS Frame Structure

MULTIFRAME 4D analyses the frame structure using first degree element analysis.

e) Result and Dicussion

The result output of the MULTIFRAME 4D is discussed in detail in chapter V.

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